

Merriam's Wild Turkey Habitat
Use and Movements

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Final Report

on

MERRIAM'S WILD TURKEY
HABITAT USE AND MOVEMENTS ^{/1}

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ABSTRACT

Habitat use and movements by Merriam's wild turkeys in southern Wasco Co., Oregon were investigated by radio-tracking 19 birds in 1981 and 48 birds in 1982. Merriam's turkeys were located most frequently in 4 forested stands: oak (18.6%), ponderosa pine/Douglas fir/oak (18.2%), mature mixed conifer (18.1%), and ponderosa pine/oak (15.2%). Mature and overmature (DBH=61.3 cm) ponderosa pine and Douglas fir in mature mixed conifer were used most frequently as roost sites. No single stand was used exclusively for gobbling activity by adult males in spring. Thinned pole size mixed conifer stands with untreated slash were used for nesting habitat by turkey hens. Adult hens dispersed an average of 12.8 km between wintering areas and nesting sites. Early successional forested stands (young mixed conifer and thinned mixed conifer) were used by hens with broods. Home ranges were large and ranged from a low of 28.2 ha for adult males in winter to a high of 676.3 ha in spring for yearling females. Individuals also were highly mobile. Daily movements ranged from 272 m/day in summer (adult females) to 735 m/day in spring (yearling males). This population is characterized by moderate to high annual turnover rates (53%), good nesting success among adult hens (83%), and low to moderate poult recruitment (1 hen:5.1 poults). To increase Merriam's wild turkey populations in Wasco County would require a better interspersation of forested:nonforested habitats adjacent (i.e. within 12.8 km) to known wintering areas.

INTRODUCTION

The ancestral range of Merriam's wild turkey (Meleagris gallopavo merriami) was the ponderosa pine (Pinus ponderosa) area of the Rocky Mountains (Ligon 1946). Merriam's turkey inhabited Colorado, Arizona, New Mexico, and west Texas (Jonas 1966). Jonas also noted that Merriam's turkeys were transplanted successfully into Montana, Wyoming, Nebraska, South Dakota, Utah, North Dakota, Idaho, Washington, California, and Oregon.

In February and March 1961, 58 Merriam's turkeys from Colorado, Arizona, and New Mexico were transplanted into Oregon: 26 hens and 12 gobblers were released on the White River Game Management Area (WRMA) in Wasco County, 10 hens and 3 gobblers were released at Garrison Butte in Jefferson County, and 5 hens and 2 gobblers were released on the Wenaha Game Management Area in Wallowa County (Mace 1965). Merriam's turkeys became established on the 3 original sites of introduction; the largest population developed in the Wasco County area (Mace 1965). Subsequently, birds were trapped near WRMA and transplanted to other sites in Oregon.

Only a limited amount of information has been published regarding habitat use by Merriam's turkeys. There is no information on habitat use by turkeys in Oregon. Scott and Boeker (1975) described Merriam's turkeys as having highly diversified food habits. Hoffman (1962) concluded that the family Graminae contributed year-round to the diet of turkeys; mast provided an important component in winter diet. Turkeys typically roost in old, large ponderosa pines on slopes with an easterly exposure (Jonas 1966, Hoffman 1968, Boeker and Scott 1969, Petersen and Richardson 1975). Grasslands and small openings in conifers are used commonly by strutting gobblers (Jonas 1966). Little information exists on nesting

habitat. Schorger (1966) stated that Merriam's turkeys typically nested on north slopes from 2000 to 3000 m in elevation. Petersen and Richardson (1975) found 24 nests in 11 years and the most common cover used for nesting was pine slash left from logging. Hens and broods were seen frequently in forest openings (Jonas 1966). Jonas noted that the size class of ponderosa pine preferred for escape cover was that most readily available; however, when given a choice, the order seemed to be poles, sawlogs, and saplings. Merriam's turkeys are highly mobile, both daily and seasonally (Scott and Boeker 1975), and require a variety of habitats to carry on life activities (Ligon 1946, Jonas 1966).

The goal of this project was to develop an understanding of the habitats used by Merriam's turkeys. This understanding would contribute to the development of a management plan to enhance or maintain populations, to assess the impacts of human use of its habitats, and to aid in the identification of potential sites that may support populations. The objective of the project was to determine and describe the habitats used by Merriam's turkeys for various life history activities. Activities were inferred by investigating habitats used during all seasons. Specific activities investigated included gobbling, nesting, brood-rearing, and roosting.

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STUDY AREA

Work took place in southern Wasco County, Oregon and included portions of Barlow and Bear Springs Ranger Districts on Mount Hood National Forest (MHNF), Oregon Department of Fish and Wildlife White River Game Management Area (WRMA), and Warm Springs Indian Reservation (WSIR). Study area boundaries were 15-mile Creek on Barlow District MHNF in the north and Boulder Creek on WSIR in the south. The eastern boundary was at 610 m elevation and 1067 m elevation was the western boundary.

MATERIALS AND METHODS

Capture

Most birds were trapped between 1 January and 15 March during 1981 and 1982. In 1981 and 1982, turkeys were captured near Pine Grove (6 trap

sites), Hazel Hollow (2 trap sites), and Friend (2 trap sites). Traps were a modified version of the type used by Jonas (1966). Traps consisted of 4 welded wire panels (3 m X 3 m) with a net wire (10 cm X 10 cm mesh) top. Birds entered the trap through 0.5 m long funnels which narrowed from a 0.5 m opening in the welded wire panel to a 0.33 m opening. There were 2 funnels/trap. After capture, all birds were weighed, age and sex was determined, measurements of the bird were made, and numbered leg bands attached. Age of the birds was determined by examining the distal portion of the 9th and 10th primaries for barring (Larson and Taber 1980). Adult birds had white barring that extended to the distal end of the 9th and 10th primaries. Yearling birds (< 1 year old) were identified by the lack of white barring on the distal 3 cm of the 9th and 10th primaries. The sex of birds was determined by examining the color of the breast feather tip, leg color, and feathering on the head (Larson and Taber 1980). In 1981 some birds were marked with colored patagial wing markers (Knowlton et al. 1964). Beards, spurs, upper mandible, and tarsometatarsus were measured to the nearest millimeter. In both years, some birds were equipped with radio transmitters (Telonics Inc., Mesa, Arizona). Transmitters were attached with a back-pack harness which consisted of rubber tubing covered by braided nylon. Transmitters operated on a frequency of 160.000 to 162.000 Mhz, weighed approximately 90 grams, and had an operational life of 12-15 months.

Relocations

Birds were relocated 3 times weekly throughout the year. A 3-element Yagi antenna was used to determine the direction of a radioed bird. After the direction of the bird was determined a compass bearing was taken to aid

in triangulating the location of the bird. At least 3 triangulation points were used to locate birds. Triangulation points were generally within 0.5 km of the bird location. Radio transmitters were placed at known locations and triangulated to determine the accuracy of triangulations. Error polygons estimated from these trials averaged 5 ha. Bird locations were plotted and identified on the Universal Transverse Mercator (UTM) grid system (Lancia 1974). Seasons were based on observations of vegetation phenology and bird activity. Seasons of use were spring (1 March-1 June), summer (2 June-1 September), fall (2 September-15 November), and winter (16 November-28 February).

Demographic characteristics

Monthly and seasonal mortality rates and mortality rates from hunting also were calculated. Monthly and seasonal mortality rates were based on the following ratio: $Q_m = \frac{N_d}{N_a}$, N_d = number of radioed birds alive on the first day of the month/season and dying during the month/season, N_a = number of radioed birds alive on the first day of the month/season. Thus monthly survival was equal to $L_m = 1.00 - Q_m$. Birds on which radios malfunctioned were excluded from the analysis. A mortality rate from hunting was the percentage (number of marked birds shot/total number of marked gobblers available) of gobblers shot during the spring turkey season. Sex and age ratios obtained from trapping were used to further describe population characteristics.

Most information on nesting resulted from nesting attempts by radioed hens. Other nests discovered accidentally were included if the nest had been completed. Poults per hen ratios were the result of counts of hen-poult groups observed during August.

Habitat Utilization

Habitat utilization was investigated at 2 levels: stands (e.g. oak, ponderosa pine-oak) and structural/species characteristics (e.g. grass cover, oak density). Stands on the study area were mapped with LANDSAT satellite imagery obtained during a flight of 9 June 1979. Fourteen stands were classified; stand maps were verified with ground-truthing. Ground-truthing consisted of comparing known stand classification (from on the ground reconnaissance) with classification of stands from LANDSAT maps. Stand use by turkeys was determined by superimposing an acetate sheet with turkey locations over a LANDSAT stand map. Then, a block of 9 (3 X 3) LANDSAT Picture elements (PIXEL's) which surrounded the turkey location was sampled. The most frequent PIXEL in the 3 X 3 sampling unit was used to describe the stand occupied by the bird.

Selection indices (Ivlev 1961) were calculated for stand and habitat structural values.. Indices resulted from the formula, $E = \frac{r-p}{r+p}$, where $\pm r'$ was the percentage of the stand/habitat variable available and $\pm p'$ was the percentage of the stand/habitat used. The sign of the indice indicated whether the variable was used greater than it was available (+), than it was available (-), or equal to the availability on the area (0).

Vegetation sampling

Cover (grass cover, forb cover, shrub density, understory density, and overstory density) and dispersion (openness in the shrub, understory, and overstory strata) were used to help describe stands used by turkeys. Four strata within the vegetation were sampled: strata included herbaceous (<1 m), shrub (<3 m), understory (trees > 3 m, but beneath the canopy), and overstory (trees forming the canopy). Species (total number of species among strata) composition also was used to characterize stands

used by turkeys. Vegetation was sampled along a 50-m transect at both random and bird locations. Random locations provided data for availability of vegetative characteristics. Using the formula, $N = \frac{t^2 s^2}{0.20 \bar{x}}$, resulted in 16 transects in oak, 21 in ponderosa pine/oak, 23 in young mixed conifer, 17 in thinned mixed conifer, 19 in ponderosa pine/Douglas fir/oak, 26 in mature mixed conifer, and 14 in ponderosa pine. Three circular plots with a 10-m radius and 25 m apart were the sampling units. Species of shrub, understory, and overstory were recorded. Percent grass cover, forb cover, understory cover, and overstory cover were estimated at random distances in each of the cardinal directions from the plot center. Percent cover was equal to an ocular estimate of a portion of the sighting tube obscured (James and Shugart 1971). Number of individuals for each species and distance to the nearest species were measured in the shrub strata. Total number of individual species, distance to the nearest species, and the diameter at breast height (DBH) of the nearest species were measured in the understory and overstory strata. To obtain an index of visual obstruction in the vegetation, 3 10-m transects were traversed and contacts with vegetation at 0.5 m (TVK) and 1.5 m (TVS) heights were recorded.

Home range and movements

Home range was used to describe the "area traversed by the individual in its normal activities of food gathering, mating, and caring for young" (Burt 1943). Seasonal home ranges of individuals were calculated with a recently developed model (Samuel et al. 1983). Input to this model consisted of individual turkey locations identified by UTM grid coordinate. Output from the model consisted of an estimate of home range size using the convex polygon method (Hayne 1949).

Distances between turkey locations were straightline measurements calculated with a Euclidean distance program developed by E. Rexstad. Distances were presented as meters per day.

Statistical analysis

Univariate and multivariate techniques were used to investigate vegetation use by turkeys. A significance level of $P < 0.05$ was used in all statistical analyses. In both statistical techniques, correlation coefficient matrices were used to identify inter-correlated variables (Nie et al. 1975:280-288). Inter-correlated variables with $r > 0.70$ were excluded and/or separated in further analyzes. The frequency of locations in habitats was compared between groups (e.g. stands, juvenile and adult birds, season of use) with Chi Square analysis (Nie et al. 1975:218-245). Stand utilization and availability data were evaluated by calculating simultaneous confidence intervals for these data (Neu et al. 1974). One-way analysis of variance (ANOVA) was used to test whether single variables could be used to differentiate groupings of birds. If groups were different, Scheffe's multiple range test (Nie et al. 1975:429-430) was used to determine which groups contributed to the difference. Stepwise multiple analysis of variance (MANOVA) (Hull and Nie 1981:32-63) was used to investigate differences in structural or species variables among the various groups of data for vegetation use by turkeys.

RESULTS AND DISCUSSION

Study area

Fourteen habitats were classified with LANDSAT satellite imagery on the 135,141 ha study area. Non-forested habitats (range, irrigated lands, grain) occupied less than 6 percent of the study area. Eleven of the

habitats on the study area were forest and were referred to as stands (Table 1). The most abundant habitat (24.6%) on the study area was the oak stand. Oak (Quercus garryana) occurred at low elevations on the eastern portion of the study area. Ponderosa pine was the next most abundant habitat and occurred on 17.8 percent of the area. Ponderosa pine was found primarily on WSIR on the southern portion of the study area. Mature mixed conifer occurred on 14.2 percent of the area. These stands were generally limited to rugged terrain at low elevation where the overstory consisted of ponderosa pine and Douglas fir (Psuedotsuga menziessi). At higher elevations these stands had an overstory of true fir (Abies spp.) and Douglas fir. The ponderosa pine/Douglas fir/oak stand occupied 12.5 percent of the area and was in a transition zone between oak and conifer stands. Other less abundant wooded habitats included ponderosa pine/oak, young mixed conifer, moist mixed deciduous, shelterwoods, new clearcuts, and old clearcuts.

Capture

In 1981, a total of 42 turkeys were captured: 6 adult males, 24 yearling males, 2 adult females, and 10 yearling females. Nineteen birds were fitted with radio transmitters in 1981 (6 adult males, 5 yearling males, 2 adult females, 6 yearling females) and 21 birds were marked with patagial tags. Based on spur and beard length, all adult males were classified as second year males not old males (Petersen and Richardson 1975).

Table 1. Descriptions of stands available for use by Merriam's turkeys in southern Wasco Co., Oregon, 1981-1982.

<u>Stand Name</u>	<u>Stand Description</u>
Oak	Stands found at low elevations (660-750 m) on the eastern edge of the study area. Oak was the dominant species in all 3 strata.
Ponderosa pine/oak	Stands also found at the eastern edge of the study area; often adjacent to oak stands. The overstory consisted of ponderosa pine and oak was consistently found in the understory.
Young mixed conifer	Stands on flat terrain that were often the result of selective logging that had removed overstory species. The result was a mixture of dense sapling to pole size conifers stands interspersed with small open areas. The open areas often had been seeded to grass.
Thinned mixed conifer	Single-story stands with a Douglas fir or ponderosa pine overstory. These stands occurred from 700-900 m and had been thinned (commercially or precommercially) during the past 15 years.
Ponderosa pine/Douglas fir/oak	Found as a transition between ponderosa pine/oak and the mixed conifer stands between 750 and 825 m. Generally there was a widely dispersed overstory with a dense understory of ponderosa pine, Douglas fir, and oak.
Mature mixed conifer	At elevations below 750 m these stands were restricted to steep north facing slopes. At these elevations, the overstory was composed of Douglas fir and ponderosa pine. At elevations above 750 m, the overstory was true fir and Douglas fir.
Ponderosa pine	Found primarily on the southern portion of the study area on the WSIR between 600 and 1000 m. Both overstory and undersory consisted of ponderosa pine.

Table 1. Continued

<u>Stand Name</u>	<u>Stand Description</u>
Mixed deciduous	These stands were most often in riparian zones. Generally, the stands consisted of dense shrub patches interspersed with small, wet meadows.
Recent clearcuts	Found primarily in the mixed conifer stands above 750 m. These habitats were logged within the past 5 years and ranged in size from 5 to 15 ha. The habitats consisted of thistle (<u>Carduus spp.</u>), fireweed (<u>Epilobium spp.</u>), and Orchard grass (<u>Dactylis glomerata</u>) in the herbaceous strata. Conifer seedlings and shrubs composed the shrub strata.
Old clearcuts	Created by logging operations within mixed conifer stands. These habitats ranged in size from 5 to 75 ha and were the result of logging 10-20 years ago. Habitats consisted of either single-story conifer plantations or dense, multi-layered shrub communities.
Shelterwoods	Generally located at the upper elevations (>900 m) in mixed conifer stands. The stands consisted of widely dispersed overstory of mature Douglas fir or true fir and a well-developed mixed conifer understory.

In 1982, 74 birds (10 adult males, 11 adult females, 32 yearling males, 21 yearling females) were captured and 48 of these were radioed. Radioed birds included 9 adult males, 11 adult females, 13 yearling males, and 15 yearling females.

Weights of all age/sex groups were similar to those reported by Jonas (1966) and Hoffman (1962); adult males were heaviest and juvenile females were lightest (Table 3). Mackey (1982) reported similar weights for the age/sex groups; although, adult males were lighter in Washington (7.48 vs. 8.52 kg).

Demographic characteristics

Most birds captured were in good condition; however two juvenile males captured in 1981 were afflicted with avian pox (diagnosed by D. Helfer, OSU Veterinary Diagnostic Laboratory). Individual with legband 110 was first caught in mid-February and no pox was noted. This individual was recaptured in mid-March and had secondary Staphylococcus spp. infections (in pox lesions) on his head and wings. The right eye was almost occluded and the left was partially (50%) occluded. When released, 110 was debilitated. Individual with legband 114 also had pox but appeared to be recovering.

Avian pox has been reported from several different species of Galliformes, but never wild turkeys (Karstad 1971). Karstad suggested that domestic flocks of chickens and turkeys may serve as a source of infection for wild birds. Avian pox was probably not an important cause of mortality in the Wasco Co. population (2/116 birds afflicted), but proximity of domestic chicken and turkey flocks should be considered in future turkey introductions.

Twenty nests were found during 1980-1982. Radioed birds resulted in

the discovery of 13 nests; 7 nests were accidentally found. Thirteen nests were complete; average clutch size in these nests was 9.3 eggs. All nests hatched during the last week in May and the first week in June. Jonas (1966) reported incubation began from 25 April to 5 May for turkeys in Montana; incubation in Wasco County began early in May. Mackey (1982) reported a mean clutch size of 8.6 eggs and 12.5 eggs for adults and yearlings, respectively. Mackey also reported hatching dates from 16 May to 16 June.

Data from radioed birds indicated differences between nesting attempts of adult and yearling females. Ninety-one percent of adult hens (10/11) that survived until the nesting season attempted to nest. Eighty-three percent of nesting attempts by adults were successful. Thirty-one percent (4/13) of the yearling hens alive during nesting season attempted to nest, and of these, 50 % were successful. Only one bird (an adult) in 2 nesting seasons appeared to reneest after an initial nesting attempt was unsuccessful. Mackey (1982) reported little difference in nesting attempts made by adults and yearlings. Porter (1978) reported 88 percent of yearling females (§1 year old) attempted to nest.

Ratios of hens:poults were calculated from 21 hen-poult flocks observed during August of both years. There was an average of 1 hen:5.1 poults. These counts are on the low-moderate end of the ranges of summer hen:poult ratios. Schorger (1966) reported average brood sizes for successful hens in New Mexico, Arizona, Colorado, and California as 6.0, 3.9, 6.0, and 3.7, respectively. Bryant (1974) found a low of 1 to 2 poults per hen in Utah. Typically, counts ranged from 6 to 7 poults per hen (Hoffman 1962, Jonas 1966, Petersen and Richardson 1975) with a high of 10.5 reported from Montana by Jonas.

Table 2. Merristic characteristics of Merriam's wild turkeys captured during January-March in southern Wasco Co., Oregon, 1981-1982.

Characteristic	^a Age/Sex Group			
	AM	YM	AF	YF
Weight (kg)	8.52(16)	6.15(68)	4.97(16)	3.87(36)
Mandible length (mm)	25.40(10)	27.32(40)	24.00(11)	23.14(22)
Beard length (mm)	198.56(16)	73.88(64)	95.00(1)	-
Tarsometatarsus length (mm)	124.81(16)	115.97(66)	108.69(16)	98.10(30)
Midtoe length (mm)	100.55(11)	94.10(42)	81.64(14)	81.57(23)
Spur length (mm)	15.00(16)	1.84(63)	1.50(1)	-

^a

AM=adult male, YM=yearling male, AF=adult female, YF=yearling female
Sample size is in parenthesis

Sex ratios calculated from captured birds indicated there were 7 males:3 females in 1981 and 6 males:4 females in 1982. Sex ratios calculated from Mackey (1982) indicated there were 4 males:6 females in the Washington population. Age ratios from captured birds varied from 2 adults:8 yearlings in 1981 to 3 adults:7 yearlings in 1982. Age ratios calculated from Mackey (1982) indicated a ratio of 3 adults:7 juveniles in turkeys in Washington.

The annual mortality rate for all age/sex groups combined was 53%. Adult males had the highest annual mortality rate (62%) and adult females had the lowest annual mortality rate (39%) (Table 3). Porter (1978) reported mortality rates of 35.8% for all males and 51.4% for all females. In Wasco County, yearling females had an annual mortality rate of 59% and adult females had an annual mortality rate of 39%. Porter reported similar differences in annual mortality rates for turkeys in southeastern Minnesota. Jonas (1966), from records of 132 individually marked Merriam's turkeys suggested that 50% of the population disappeared each year. In South Dakota, annual mortality for adult Merriams' banded as juveniles was 77.1%, and annual mortality for juvenile males was 41.3%. Studies on eastern and Florida (M. g. osceola) turkeys (Wischonofski 1960, Bailey and Rinell 1967, Powell 1967, Speake et al. 1969, Lewis and Kelly 1973) revealed annual turnover rates of 30 to 76%. Monthly mortality rates for Wasco County birds indicated late winter and spring were seasons with the highest mortality rates. Monthly mortality rates ranged from 0.00 to 0.50. Porter (1978) also reported winter and spring were seasons of high mortality; monthly mortality rates ranged between 0.029 and 0.166 for a transplanted population of turkeys in southeastern Minnesota.

Mortality of marked birds (radioed and legbanded) during the spring

Table 3. Monthly mortality rates for 4 age/sex groups of Merriam's turkeys in southern Wasco Co., Oregon, 1981-1982.

Time period	Age/sex group ^a			
	AM	YM	AF	YF
January-February				
1981	0.33	0	0	0.17
1982	0.20	0.09	0	0.30
March				
1981	0	0.20	0	0.40
1982	0	0	0	0
April				
1981	0	0.25	0	0.40
1982	0.40	0.11	0.09	0
May				
1981	0.50	0	0	0
1982	0	0.13	0	0
June				
1981	0.50	0	0	0.50
1982	0.20	0	0	0
July				
1981	0	0	0	0
1982	0	0.13	0	0
August				
1981	0	0	0	0
1982	0	0.14	0.10	0
September				
1982	0	0.17	0.11	0
October				
1982	0	0.20	0	0
November				
1982	0	0	0	0
December				
1982	0	0	0	0
Mean monthly mortality rates				
1981	0.22	0.08	0.08	0.23
1982	0.07	0.09	0.03	0.03
Annual mortality rates				
1981	0.83	0.40	0.50	0.67
1982	0.40	0.64	0.27	0.50

^a

AM=adult male, YM=yearling male, AF=adult female, YF=yearling female

hunting season ranged from 27.7% in 1981 to 33% in 1983. Hunting (1964-1971) recovered 31.3% of the banded bird population in South Dakota (Petersen and Richardson 1975). Lewis and Kelly (1973) reported a first season hunting season recovery rate of 19% for birds in Missouri, a rate that did not impair reproduction.

A total of 30 radioed birds were killed during 1981-1982. Predators (coyotes(Canis latrans), bobcats(Felix rufus)) accounted for 80% of these losses. Other causes of mortality included hunting (6.7%), accidents (6.7%), stress from handling (3%), and poaching (3%). Porter (1978) reported predators accounted for 70% of the mortality of radioed birds in southeastern Minnesota.

Habitat utilization

Habitats selected

Turkeys used 11 of the 15 habitats available on the study area. Four stands accounted for 70 percent of the 2288 turkey locations (Table 4). These stands were oak (18.6%), ponderosa pine/Douglas fir/Oak (18.2%), mature mixed conifer (18.1%), and ponderosa pine/oak (15.2%). Six habitats had positive selection indices; i.e. stands were used more frequently than they were available. These stands were ponderosa pine/oak, young mixed conifer, moist mixed deciduous, thinned mixed conifer, ponderosa pine/Douglas fir/oak, mature mixed conifer stands. Habitats with negative selection indices were the oak stand and 3 non-forested habitats (grassland, irrigated pastures, grain crops).

Specifically, stands used by turkeys were characterized by more abundant grass and forb cover and a greater understory density than random stands. Turkeys used stands that were more open near the ground and also

Table 4. Percentages of habitats available on the study area, turkey locations (n=2288) in these habitats, and selection indices for habitat used by Merriam's turkey in southern Wasco Co., Oregon, 1981-1982.

<u>Habitat</u>	<u>Available</u>	<u>Used</u>	<u>Selection Index</u>
Rangeland	0.6	0.1	-0.71
Irrigated pastures	0.3	0.2	-0.20
Grain fields *	4.6	3.2	-0.18
Oak *	24.6	18.6	-0.14
Ponderosa pine/oak *	9.5	15.2	+0.23
Young mixed conifer *	7.7	10.0	+0.13
Mixed deciduous	0.2	0.3	+0.20
Thinned mixed conifer *	7.8	12.6	+0.20
Ponderosa pine/Douglas fir/ Oak *	12.5	18.2	+0.19
Mature mixed conifer *	14.2	18.1	+0.12
Ponderosa pine *	17.8	3.3	-0.69
Recent clearcuts	0.1	0	-1.0
Old clearcuts	0.6	0	-1.0
Shelterwoods	0.1	0	-1.0

* indicates a difference at the 0.05 level of significance

more open in the shrub and overstory layers. Generally, stands used by turkeys were characterized by tree species such as oak, ponderosa pine, and incense cedar (Libocedrus decurrens) associated with drier and harsher sites. Almost all shrub species were selected against; which again indicated selection for an open shrub layer.

Utilization of stands

Oak

Oak stands were used during all seasons, but the majority (32%) of use occurred during winter. Older aged oak stands (DBH's 26.1 cm vs. 16.9 cm) were used by turkeys. These stands were characterized by a dense understory of oak and a widely dispersed oak overstory. There was also more obstruction of vision in oak stands used by turkeys.

Ponderosa pine/Douglas fir/Oak

These stands recieved the most use in spring(44%) and summer(22%). Use was primarily by females and yearling males. Stands used had more grass and forb cover, a greater understory density, and overstory density than transition stands not used by turkeys. Transition stands had positive selection indices for oak, ponderosa pine, and bitterbrush. Snowberry was selected against in these stands.

Mature mixed conifer

Mature mixed conifer stands were used mostly in spring (47%) and winter (27%). These stands also were used almost exclusively for roost sites. A total of 39 sites with 118 trees was sampled to describe roost sites. A roost site consisted of an average of 3 trees (range 1 to 9); ponderosa pine was the most common species used as a roost tree (60%). The

remaining roost trees were Douglas fir. Roost trees were mature and overmature trees (Baker 1950) with a DBH of 61.3 cm, distance to first living limb of 10.3 m, and a crown depth of 7.8 m. Most roosts were found between 600 and 800 m (\bar{x} of 745 m) and were lightly used, although, a few traditionally used (heavy use) roost trees were found. Mature mixed conifer stands were characterized by abundant grass and forb cover, an open shrub layer with little obstruction, a dense understory, and an open overstory. Ponderosa pine and oak characterized these stands. True firs and Douglas fir were species that were selected against.

Ponderosa pine/oak

These stands were used most frequently in spring. Grass and forb cover (>10%), a sparse and widely dispersed shrub layer, and a dense understory characterized the ponderosa pine/oak stands use by turkeys. Stands used had more Douglas fir, oak, and snowberry and less bitterbrush than ponderosa pine/oak stands not used by turkeys.

Thinned mixed conifer

These stands were used primarily during the spring season. Of the 20 nests sampled, 13 (65%) were located in thinned mixed conifer stands. These stands also were used during summer by adult females with broods. Important characteristics of thinned stands included abundant forbs, a dense shrub layer, an understory composed of pole size (\bar{x} DBH = 9.8 cm) conifers, with much obstruction near the ground. In most cases this obstruction was provided by dead and down woody material (slash). Fuel management manuals (Maxwell and Ward 1976), were used to estimate slash weights in study area thinned mixed conifer stands, which ranged between 30 and 40 tons/ha. Oak, Douglas fir, and snowberry were species with positive

selection indices whereas ponderosa pine and grand fir were selected against.

Young mixed conifer

These stands were used most frequently (41%) during spring, but also used (30%) consistently in winter. Forb cover and lack of obstruction close to the ground (<0.5 m) were structural variables selected for in these stands. Oak was the only species selected for in these stands which indicated that young mixed conifer stands used by turkeys were on relatively dry sites.

Ponderosa pine

These stands were most frequently used during summer by females of both age classes. Grass and forb cover, a widely dispersed shrub strata, and a dense understory were features selected for in ponderosa pine stands. The overstory was widely dispersed (200/ha) ponderosa pine. Lack of visual obstruction at ground level, but with visual obstruction at 1.5 m height were also features selected for in ponderosa pine stands used by Merriam's turkeys.

Other habitats

Grain fields received some use during fall and winter, primarily by hen-poult flocks. Irrigated pastures and mixed deciduous habitats received limited use by hens with broods during summer. Both these habitats were associated with open water sources, which may have been important during summer. Rangeland was used throughout all seasons. Both ages of clearcuts and shelterwoods were avoided by Merriam's turkeys in southern Wasco Co.

Seasonal activities by age/sex groups in stands

This population made very little use of non-forested habitats on the study area (Table 5); reports from other populations of Merriam's turkeys

Table 5. Frequency of habitats used and features selected in habitats used by Merriam's wild turkey in southern Wasco Co., Oregon 1981-1982.

Habitat	Frequency of turkey use	Selected features	Comments
Oak	18.6	Dense understory; open, old overstory; abundant grass cover	Hen-poult use in winter,
PP/DF/O	18.2	Grass and forb cover; dense understory and overstory	Used in spring
MMC	18.1	Large old PP and DF	Roosting, used in spring
PP/O	15.2	Grass and forbs; open shrub layer; dense understory	Used in winter
TMC	12.6	Forbs; dense shrub layer; untreated slash	Nesting, brood-rearing
YMC	10.0	Forbs	Used in spring
PP	3.3	Grass and forb cover;	Used in summer
Grain fields	3.2	-	Used in fall and winter
Mixed deciduous	0.3	-	Used in summer
Irrigated pastures	0.2	-	Used in summer
Range	0.1	-	Some use all year
Recent clearcuts	0	avoided	
Old clearcuts	0	avoided	
Shelterwoods	0	avoided	

indicated birds used available non-forested habitats (Jonas 1966, Bryant and Nish 1975). In California, potential Rio Grande turkey habitat has been identified as areas that were at least 50% forested and 20% non-forested (Katibah and Graves 1978). Less than 10% of the Wasco County study area was non-forested and most activities were in forested habitats. In fact, 4 forested stands accounted for 70% of all turkey locations.

Turkeys were in 2 distinct flocks in winter. Adult male groups ranged in size from 3 to 8 individuals and hen-poult flocks ranged from 20-100 individuals. The hen-poult flocks in Wasco Co. used stands at lower elevations than male flocks and often at the edge of forested and non-forested habitats. Hen-poult flocks in winter used habitats within a small area (5150 ha). By comparison, adult males used stands at higher elevations such as ponderosa pine/Douglas fir/oak and young mixed conifer. A mountain brush habitat at low elevations was most often used by Merriam's turkeys in Arizona (Scott and Boeker 1973) and Utah (Bryant and Nish 1975). Oak habitat was preferred in winter by Merriam's turkeys in southcentral Washington (Mackey 1982). Jonas reported that a Ash (Fraxinus pennsylvanica) Box elder(Acer negundo)-Hawthorn (Craetagus succulenta) Plum (Prunus americana) community at the forest edge was used most frequently during winter. Hoffman (1962) reported that most turkeys wintered in ponderosa pine-scrub oak (Quercus spp.) communities in Colorado.

Many stands were used by turkeys in spring. Beginning early in March, adult females dispersed from the hen-poult flocks and habitats used during winter. In spring, stands at higher elevations (Ponderosa pine/Douglas fir/oak and mature mixed conifer) were used most frequently by dispersing birds. Wear on the distal primaries was recorded on males recovered during the spring to determine whether the birds had been displaying. Most adult

males displayed during spring, whereas, only a few yearling males had displayed. No single stand appeared to be exclusively used for gobbling by adult males. Adult males used a variety of stands during spring; adult males may have moved with dispersing adult females. Jonas (1966) reported that turkeys were observed most frequently in a sedge (Carex spp.)-Blue grama (Bouteloua gracilis)-Bluestem wheatgrass (Agropyron smithii) community in spring. Jonas also observed courtship groups most frequently in grassland communities in spring. Bryant (1974) stated that Merriam's turkey in Utah did not have traditional strutting grounds, but he did not identify strutting habitat. Jonas (1966) and Petersen and Richardson (1975) did not believe yearling males participated in breeding, although Burget (1957), Eng (1959), and Suetsuga and Menzel (1963) reported yearling (§1 year old) males bred successfully. Seventeen of 20 nests were in early successional conifer stands. These stands were thinned mixed conifer (65%), sanitation/salvage logging units in mixed conifer (10%), and selectively logged mixed conifer (10%).

In summer, adult males and juvenile females were similar in use of stands. Both groups were located in the more xeric habitats such as oak, ponderosa pine/oak, and ponderosa pine/Douglas fir/oak. On the other hand, adult hen and yearling males were located in early successional conifer stands (e.g. young mixed conifer and thinned mixed conifer). These stands often had small openings dispersed among the timber. Brood habitat in Wasco Co. consisted of large acreages of forested habitat interspersed with small openings. Hens with broods reportedly used early successional stages such as clearings or old fields (Pack et al. 1980). In southeastern forests, small openings (<5 ha) were maintained in the forest for turkey brood habitat (Speake et al. 1975). Openings are thought to be a critical

factor in turkey brood habitat. Openings ranged from mowed fields to agricultural fields (corn, alfalfa) adjacent to forested habitats. Lewis (1964) indicated areas composed of a minimum of 10% open field were optimal for broods, whereas Dickson et al. (1978) suggested maximum poult production occurred in blocks of habitat with 20% of the area in openings. Insects and seeds from grasses, often more abundant in openings, were important food for poults during summer (Hurst and Stringer 1975, Hurst 1978). Mackey (1982) reported Merriam's hens with broods commonly used oak habitat. Jonas (1966) indicated that hens with poults were most often sighted in a brush-grassland ecotone (snowberry community) and a grassland community.

Oak and ponderosa pine/oak stands were the most frequently used stands during fall. Generally, the "fall shuffle" resulted in individuals returning to areas used during the previous winter. Fidelity to wintering areas was high; 90% of the radioed birds returned to the wintering areas used during the previous winter. Jonas reported Merriam's turkeys in Montana had traditional wintering grounds; 57% of marked birds returned to wintering areas and 87% returned to the same summer range. Hens that nested within 12.8 km (mean distance between wintering areas and nest sites) of the wintering area were much more likely (80%, n=10) to return to the wintering area with poults than hens that nested further away from the wintering area (0%, n=5).

Home range and movements

Home range size changed seasonally (Table 6). Smallest seasonal home range size was 28.2 ha in winter and largest home range size was 676.3 ha in spring. Data from radioed birds in Klickitat County,

Table 6. Home range size (Minimum area polygon) and daily movements of 4 age/sex groups of Merriam's wild turkey during 4 seasons in Wasco Co., Oregon, 1981-1982.

Age/sex ^a	Season							
	Winter		Spring		Summer		Fall	
	HR ^b	DM ^c	HR	DM	HR	DM	HR	DM
AM	28.2	367	257.0	530	129.3	340	104.4	506
YM	312.4	530	496.3	735	153.9	524	252.3	712
AF	51.2	481	258.4	554	88.3	272	185.8	505
YF	47.3	544	676.3	771	302.9	392	246.6	518

^a AM=adult male, YM=yearling male, AF=adult female, YF=yearling female

^b HR=home range estimate

^c DM=meters/day

Washington indicated the same seasonal trend, although, home range size was much smaller in the Washington birds (23.8-177.5 ha). Brown (1980) surveyed 10 publications on home range size in eastern wild turkeys and reported an average seasonal home range size of 286 ha. Among age/sex groups, all groups had the largest home range in spring, and all groups except yearling males had the smallest home range in winter. Yearling male home range size was smallest in summer.

Throughout the year, adults had smaller home ranges than yearlings. Adult males had smaller home ranges (129.7 ha) than adult females (145.9 ha). Yearling females had smaller home ranges (303.4 ha) than yearling males (447.3 ha).

Daily movements also differed among seasons and age/sex groups (Table 5). Shortest daily movements occurred in winter and longest daily movements occurred in spring. Fall and spring daily movements reflected seasonal dispersal by turkeys. Generally, birds captured and radioed in the Pine Grove and Hazel Hollow trap sites dispersed south in the spring onto the McQuinn strip and WSIR. The maximum distances moved between trap site and subsequent relocations (60.0 km) were recorded for yearlings. Nesting females moved an average of 12.8 km (range 2.5 to 55.0 km) between wintering areas and nesting sites. The maximum seasonal distance moved was 55.0 km for adult females and 16.0 km for adult males.

MANAGEMENT RECOMMENDATIONS

Merriam's turkey populations in southern Wasco Co. were characterized by moderate to high annual mortality rates, good nesting success among adult hens, and low to moderate poult recruitment. To increase Merriam's turkey populations in southern Wasco Co. would require the cooperation of ODFW, MHNF, and WSIR land management agencies. Because turkeys are mobile,

large acreages need to be managed. Known wintering areas could be used as focal points of land management. Habitats between the forest edge and 3000 m elevation within 13 km of a known wintering area could serve as a turkey habitat management unit. Habitats within the management unit should include an even distribution of mature, mixed conifer stands, older-aged oak stands, and early successional conifer stands. A general objective for habitat management, would be to create a better interspersed of forested and open habitats, that is, to approach the non-forested:forested ratios reported from other populations of Merriam's turkeys. Open habitats could either be in the form of non-forested habitats or more small openings within forested habitats. Forested stands should be manipulated so that there is 20-30% overhead cover in these stands. Removal of 65% of mature ponderosa pine from 5000 ha in Arizona had little effect on Merriam's turkey populations (Scott and Boeker 1975). Slash should be left untreated in some thinned mixed conifer stands to provide nesting areas. Roosts should be provided by small acreages of mature ponderosa pine maintained across these low elevation habitats. Scott and Boeker (1977) reported roost sites isolated by more than 300 m from escape cover were abandoned as by Merriam's turkeys. Because adult hens contributed heavily to poult production, either sex fall hunting seasons are not recommended for current Wasco Co. populations of Merriam's turkeys.

Potential habitat for Merriam's turkeys in Oregon would include low elevation ponderosa pine stands with good grass cover. Mature ponderosa pine, for roosts, would be dispersed in these stands to provide roost sites. Thinned pole size stands, preferably with untreated slash, should be available for nesting habitat. Non-forested:forested habitat ratios should be considered when potential transplant sites are identified.

Transplant efforts would ideally consist of 20-25 individuals with a sex ratio of 1 male:4-5 hens. The majority of hens should also be adults. Winter, because birds were relatively less mobile during this season, would be the best time to transplant birds. Six to 8 of the birds in the transplanted group should be equipped with radio transmitters to monitor habitats/stands used by transplanted birds. Birds should also be transplanted over a 3-year period to maximize success of the introduction.

Poult production (late summer counts) and population size and characteristics (age and sex ratios) are probably the most feasible parameters to monitor to evaluate land management activities and/or transplant efforts.

LITERATURE CITED

- Bailey, R. W., and K. T. Rinell. 1968. History and management of the wild turkey in West Virginia. West Virginia Dept. Nat. Res. Div. Game and Fish Bull. No. 6. 59pp.
- Baker, F. S. 1950. Principles of silviculture. McGraw-Hill Book Co. New York, N.Y. 414pp.
- Boeker, E. L. and V. E. Scott. 1969. Roost tree characteristics for Merriam's turkey. J. Wildl. Manage. 33:121-124.
- Brown, E. K. 1980. Home range and movements of wild turkeys--a review. Pages 251-261 In J. M. Sweeney, ed. Proc. Fourth Natl. Wild Turkey Symp. Little Rock, Arkansas. 292pp.
- Bryant, F. C. 1974. Life history and habitat utilization in southwestern Utah. Utah Dept. of Nat. Res., Div. of Wildl. Res. Publ. No. 74-6. 88pp.
- , and D. Nish. 1975. Habitat use by Merriam's turkeys in southwestern Utah. Pages 6-13 In L. K. Halls, ed. Third Natl. Wild Turkey Symp. Texas Chapt. Wildl. Soc. San Antonio, Texas. 227pp.
- Burget, M. L. 1957. The wild turkey in Colorado. Colorado Dept. of Game and Fish. P.R. Rept. 39-R-1. 67pp.
- Burt, W. H. 1943. Territoriality and home range concepts as applied to mammals. J. Mammal. 24:346-352.
- Dickson,, J. G., C. D. Adams, and S. H. Hanley. 1978. Responses of turkey populations to habitat variables in Louisiana. Wildl. Soc. Bull. 6:163-166.

- Eng, R. L. 1959. Status of turkey in Montana. Proc. First Natl. Wild. Turkey Symp. 1:19-20.
- Hayne, D. W. 1949. Calculation of size of home range. J. of Mammal. 39:190-206.
- Hoffman, D. M. 1962. The wild turkey in eastern Colorado. Colo. Game and Fish Dept. Tech. Bull. No. 12. 47pp.
- , 1968. Roosting sites and habitat of Merriam's turkeys in Colorado. J. Wildl. Manage. 32:859-866.
- Hull, C. H., and N. H. Nie. 1981. Update 79: New procedures for SPSS McGraw-Hill Book Co., New York, N. Y. 402pp.
- Hurst, G. A. 1978. Effects of controlled burning on wild turkey poult food habits. Proc. Southeast Assoc. Game and Fish Agencies. 32:30-37.
- , and B. D. Stringer, Jr. 1975. Food habitats of wild turkey poults in Mississippi. Pages 76-85 In L. K. Halls, ed. Proc. Third Natl. Wild Turkey Symp. San Antonio, Texas. 227pp.
- Ivlev, V. S. 1961. Experimental ecology of the feeding of fishes. Yale Univ. Press, New Haven, Conn. 302pp.
- James, F. C., and H. H. Shugart, Jr. 1971. A quantitative method of habitat description. Audubon Field Notes. 24:727-736.
- Jonas, R. J. 1966. Merriam's turkey in southeastern Montana. Montana Fish and Game Dept. Bull. No. 3. 64pp.
- Katibah, E. F., and W. C. Graves. 1978. Remote sensing-aided assessment of wild turkey habitat. Pages 78-81 In M. E. Berger, Gen. Chairman Application of remote sensing data to wildlife management. National Wild. Fed., Scientific and Tech. Series No. 3. 397pp.
- Karstad, L. 1971. Pox. Pages 34-58. In J. W. Davis, R. C. Anderson, L. Karstad, D. O. Trainer, ed. Infectious and parasitic diseases

- of wild birds. The Iowa State Univ. Press, Ames. 344pp.
- Knowlton, F. F., E. D. Michael, and W. C. Glazener. 1964. A marking technique for field recognition of individual turkeys and deer. J. Wildl. Manage. 28:167-170.
- Lancia, R. A. 1974. A universal grid system for map locations. Wildl. Soc. Bull. 2:72.
- Larson, J. S., and R. D. Taber. 1980. Criteria of sex and age. Pages 190-196 In S. D. Schemnitz, ed. Wildlife Management Techniques Manual. The Wildl. Soc., Washington, D. C. 686pp.
- Ligon, J. S. 1946. History and management of Merriam's wild turkey New Mexico Game and Fish Comm. Santa Fe, New Mexico. 84pp.
- Lewis, J. C. 1964. Populations of wild turkey in relation to fields. Proc. Southeastern Game and Fish Comm. 18:49-56.
- Lewis, J. B., and G. Kelly. 1973. Mortality associated with the spring hunting of gobblers. Pages 295-299 In G. C. Sanderson and H. C. Shultz, ed. Wild turkey management: Current problems and programs. Univ. of Missouri Press, Columbia. 355pp.
- Mace, R. U. 1965. Turkey talk. Oregon State Game Comm. Bull. 5:3-6
- Mackey, D. L. 1982. Ecology of Merriam's turkeys in southcentral Washington with special reference to habitat utilization. M.S. Thesis, Washington State Univ., Pullman. 77pp.
- Maxwell, W. G., and F. R. Ward. 1976. Photo series for quantifying forest residues in the ponderosa pine type. USDA, USFS Gen. Tech. Rept. PNW-52.
- Neu, C. W., C. R. Byers, and J. M. Peek. 1974. A technique for analysis of utilization-availability data. J. Wildl. Manage. 38:541-545.
- Nie, N. H., C. H. Hull, J. G. Jenkins, K. Steinbrenner, and D. H. Bent.

1975. SPSS: Statistical package for the social sciences. 2nd edition
McGraw Hill Book Co., New York, N. Y. 675pp.
- Pack, J. C., R. P. Burkert, W. K. Igo, and D. J. Pybus. 1980. Habitat
utilized by wild turkey broods within Oak-Hickory forests in West
Virginia. Pages 213-224 In J. M. Sweeney, ed. Fourth Natl.
Wild Turkey Symp. Little Rock, Arkansas. 292pp.
- Petersen, L. E., and A. H. Richardson. 1975. The wild turkey in the
Black Hills. South Dakota Dept. of Game, Fish and Parks Bull.
No. 6. 51pp.
- Porter, W. F. 1978. The ecology and behavior of the wild turkey
(Meleagris gallopavo) in southeastern Minnesota. Ph.D.
Dissertation. Univ. of Minnesota, Minneapolis. 122pp.
- Powell, J. A. 1967. Management of the Florida turkey and the eastern
turkey in Georgia and Alabama. Pages 409-451 In O. H. Hewitt, ed.
The wild turkey and its management. The Wildl. Soc., Washington,
D. C. 589pp.
- Samuel, M. D., D. J. Pierce, E. O. Garton, L. J. Nelson, and K. R. Dixon
1983. User's manual for program home range. For., Wildl., and Range
Experiment Station Tech. Rep. 15. Univ. of Idaho, Moscow. 64pp.
- Schorger, A. W. 1966. The wild turkey: Its history and domestication.
Univ. of Oklahoma Press. Stillwater, Oklahoma. 625pp.
- Scott, V. E., and E. L. Boeker 1972. An evaluation of wild turkey calls
in Arizona. J. Wildl. Manage. 36:628-630.
- , and -----. 1975. Ecology of Merriam's wild turkey on the Fort
Apache Indian Reservation. Pages 141-158 In L. K. Halls, ed.
Proc. Third Natl. Wild Turkey Symp. San Antonio, Texas 227pp.
- , and -----. 1977. Responses of Merriam's turkeys to pinyon-juniper
control. J. Range Manage. 30:220-223.

- Speake, D. W., L. H. Barwick, H. O. Hillestad, and W. Stickey. 1969.
Some characteristics of and expanding turkey population. Proc.
Southeast Assoc. Game and Fish Comm. 23:46-58.
- , T. E. Lynch, W. J. Fleming, G. A. Wright, and W. J. Hamrick
1975. Habitat use and seasonal movements of wild turkeys in the
southeast. Pages 122-130 In L. K. Halls, ed. Proc. Third Natl.
Wild Turkey Symp. San Antonio, Texas. 227pp.
- Suetsuga, H. Y., and K. E. Menzel. 1963. Wild turkey introductions in
Nebraska. Trans. N. Am. Wildl. Conf. 28:297-309.
- Wischonofski, M. G. 1960. Turkey harvest information. New Mexico Fed.
Aid in Wildl. Rest. Proj. W-93-R-2.

Appendix A. Value of structural characteristics of stands (n=706) used by Merriam's wild turkey in southern Wasco Co., Oregon, 1982.

<u>Stand</u>	<u>Structural Variables</u>											
	GCO	FCO	SDEN	SDIS	UDEN	UDIS	UDBH	UCOV	ODEN	ODIS	ODBH	OCOV
Oak	19	5	408	5.6	545	7.7	7.8	5	139	6.6	16.7	22
PP/O	11	6	630	4.6	574	5.6	8.1	10	233	8.1	23.6	10
YMC	5	5	504	5.6	721	5.3	7.6	12	196	7.8	26.4	16
TMC	4	2	1152	5.5	304	8.5	6.6	2	313	5.6	20.3	34
PP/DF/O	5	5	1075	4.9	777	4.8	7.8	12	259	7.4	28.4	20
MMC	2	4	617	6.9	747	6.5	8.6	11	200	7.6	37.8	29
PP	10	6	657	6.4	753	6.4	7.7	6	198	8.1	32.5	12

a

PP/O=ponderosa pine/oak,YMC=young mixed conifer,TMC=thinned mixed conifer, PP/DF/O=pponderosa pine/Dougflas fir/oak,MMC=mature mixed conifer,PP=ponderosa pine

b

GCO=grass cover,FCO=forb cover,SDEN=shrub density (#/ha),SDIS=shrub dispersion (m),UDEN=understory density (#/ha),UDIS=understory dispersion (m) UDBH=understory DBH (cm),UCOV=understory cover,ODEN=overstory density (#/ha),ODIS=overstory dispersion (m),ODBH=overstory DBH (cm), OCOV=over-story cover